2

ON *CYATHOPHYLLUM MANSFIELDENSE* DUN 1898: LOWER DEVONIAN, LOYOLA, VICTORIA

By D. L. Strusz

Bureau of Mineral Resources, Geology and Geophysics, Canberra, A.C.T.

Abstract

This revision is based on original material from the George Sweet Collection of the National Museum of Victoria; the specimen figured by Dun is chosen lectotype. The species, which is solitary or possibly weakly colonial, is considered to belong to *Acanthophyllum* (*Neostringophyllum*) *sensu* Birenheide. The corallite wall is shown to consist of the expanded bases of lath-like septal trabeculae, without the addition of lamellar sclerenchyme.

The species is known from the Lower Devonian of Loyola and the Tyers River.

Introduction

The writer first became interested in *Cyathophyllum mansfieldense* while preparing a paper on acanthophylloid corals from the Garra Formation of N.S.W. At that time, no specimens could be found, but Mr T. Darragh (National Museum of Victoria) has since made a thorough search of the Sweet Collection, when he found several specimens which he forwarded for examination. A second search by the writer revealed a few more specimens, so that enough were available for a complete revision of Dun's species. One of the specimens proved to be that from which Dun cut his figured sections, and is therefore designated lectotype. Another has thrown considerable light on the wall structure of this particular group of rugose corals. The study has also led to a revision of the subgeneric assignment assumed in Strusz (1966, p. 550).

For discussion of the morphology and taxonomy of the group, the reader is referred to Birenheide (1961).

Specimens in the palaeontological collection of the National Museum of Victoria are indicated by the prefix NMP, those in Sydney University by SUP. Thin section numbers of fossils in the Australian Museum are prefixed by AM. The following abbreviations are used: D_c = corallite diameter, D_t = diameter of tabularium, n = number of septa, n' = number of major septa, L_1 = length of major septa (relative to corralite radius R), L_2 = length of minor septa.

Systematic Description

Genus **Acanthophyllum** Dybowski 1873

Subgenus **Neostringophyllum** Wedekind 1922 *sensu* Birenheide 1961

A. (Neostringophyllum) mansfieldense (Dun 1898)

Cyathophyllum mansfieldense Dun 1898, p. 87, Pl. 3, fig. 3-4.
Acanthophyllum mansfieldense (Dun); Hill 1939, p. 223, Pl. 15, fig. 1-3.
non *Acanthophyllum* sp. cf. *mansfieldense* (Dun); Hill 1940, p. 152, Pl. 2, fig. 1a, b. This is *Pseudochonophyllum pseudoheliantheides*—see Strusz 1966, p. 564.
nec *Acanthophyllum*? *mansfieldense* (Dun); Hill 1942a, p. 146, Pl. 2, fig. 1.
nec? *Acanthophyllum* cf. *mansfieldense* (Dun); Hill 1942b, p. 188, Pl. 5, fig. 1. This may be *A.* (*Neostringophyllum*) *implicatum*—see Strusz 1966, p. 554.

Acanthophyllum mansfieldense (Dun); Philip 1962, p. 186, Pl. 26, fig. 11-12.
Acanthophyllum mansfieldense (Dun)?; Philip 1962, p. 241, Pl. 26, fig. 9-10.

DIAGNOSIS: Solitary or weakly colonial *Acanthophyllum* with sharp-rimmed inversely conical calice, up to 4 cm diameter; about 56-60 septa strongly dilated wedgewise peripherally, and spindlewise in concentric zones, the dilatation often spreading on to dissepimental surfaces making the septa appear as barbed spearheads in transverse section; D_t about 0·3 D_c, tabulae incomplete, tabular floor turned up at dissepimentarium, weakly depressed axially.

TYPE MATERIAL: Dun, when erecting this species, mentioned that it was based on several specimens collected by Sweet from Mansfield, but did not designate a holotype. Hill (1939) based her description on two specimens collected by Ripper, housed in the University of Melbourne. The original material is in the National Museum, as mentioned previously. One of the specimens, already sectioned, bore the old number (probably given by Sweet) LLQ/54. The sections were not in the National Museum, but have since been found in the Australian Museum by Dr A. J. Wright, and bear both the AM numbers, and the number LLQ/54; they are the ones figured by Dun. I here designate as lectotype this specimen NMP 24207, with two sections cut by myself, and the original sections AM 3809, 3810.

The paralectotype specimens in the Sweet Collection are: NMP 24208 (LLQ/7), with one section; NMP 24209 (LLQ/9); NMP 24717, with two sections (and two of *Trapezophyllum elegantulum*); NMP 24718 (LW/44), with two sections (which also contain *Thamnophyllum reclinatum*).

TYPE LOCALITY: Stated by Dun to be limestone outcrops at Mansfield, Victoria; Hill (1939) specified 'Griffith's Quarry, Loyola, near Mansfield', and several of Sweet's specimens are so labelled. See Boucot et al. (1966, p. 367). The limestone, as seen from the matrix of Sweet's specimens, is a medium grey rather stylolitic skeletal calcilutite, containing scattered tentaculitids. The surfaces of the corals show little wear, and are encrusted with equally un-worn auloporids? and calcareous algae. The environment was probably relatively sheltered, and below wave base; the corals seem to be at or near their growth positions.

DESCRIPTION OF LECTOTYPE: The corallites form a small clump, radiating from a point since removed by weathering; this strongly suggests a small colony, but no offsets are visible. The corallites are all slowly expanding adults. Their surfaces appear to be irregularly, but not strongly, wrinkled; septal grooves are lacking. In cross section the corallites tend to be irregularly oval in shape because of mutual interference. The calice seems to be rather deep, with a sharp rim, fairly steep walls showing a gentle sigmoidal curvature, and a narrow concave base having a weak axial depression.

The maximum measured diameter is 29·4 mm; the average of 8 measurements is 22·3 mm. In four transverse sections, the septa number from 54 to 60.

The corallite wall comprises an epitheca about 50μ thick (appearing as a thin dark film), lining a fibrous stereozone which appears to be in complete structural continuity with the septa. The stereozone is 0·4-1·5 mm wide, averaging about 1 mm. There is no sign of lamellar sclerenchyme.

The septa emerge from the stereozone as wedges up to 2·2 mm long. The dilatation in this peripheral concentric zone is quite variable, but generally strong. There is a fairly regular concentric zone of moderate to strong fusiform dilatation a little outside the tabularium. Adaxially the septa become thin or only slightly dilated; a weak concentric zone of fusiform dilatation may develop just inside the

tabularium. Between these zones the septa remain moderately dilated. In AM 3810, in a sector where the dissepimentarium has extended outward a little, the peripheral zone of dilatation remains concentric, and short segments of only moderately dilated septa separate it (with septa now fusiform) from a narrow peripheral zone of wedgewise dilatation.

In the zones of dilatation, the tissue spreads over the dissepimental surfaces as fibrous coatings. If these are thin, and particularly if the dissepiments are abaxially geniculate, the effect is to give the septa, in transverse section, the appearance of barbed sprearheads pointing to the axis. If they are thick (as in part of AM 3810) a weak inner stereozone may form.

The septa are radial and at most only gently wavy. Their sides are smooth, and develop weak flanges in the tabularium (these are horizontal or inclined upwards at a very low angle); there are neither carinae nor vepreculae (Pedder 1966, p. 181). The peripherally continuous septa may become discontinuous near and in the tabularium. The minor septa are a little unequal, but generally end at the tabularium—i.e. at about 0·7*R*—except in most cases for one pair which may reach 0·8*R*. The major septum flanked by this pair is otherwise undistinguished from the others; it may be the cardinal septum, but this cannot be proved. No pattern of septal insertion is otherwise discernible. The major septa, extending unequally towards the axis, may reach it, but generally average about 0·9*R*. In one corallite in section NMP 24207a they are uniformly withdrawn to 0·8*R*, leaving a circular axial space of 3·7 mm. In another there is double insertion of minor septa, without crowding, in six of the twenty-four major loculi (Fig. 1).

FIG. 1—Transverse section of one corallite from the lectotype, NMP 24207, approx. × 2·0. Several loculi between major septa are occupied by two minor septa instead of the usual one (indicated by twin circles). Note also the pair of elongate minor septa (arrowed). Drawn from photograph; fibrous dissepimental coatings have been omitted.

The slender trabeculae (generally less than 0·15 mm in longitudinal section) are parallel and densely packed, without intervening lamellar sclerenchyme, and continue into the wall. The microstructure is obscure, but seems to be finely monacanthine. The angle of inclination from the vertical is large, but may differ markedly on opposite sides of a corallite. It is least at about the middle of the

dissepimentarium, increasing moderately abaxially and adaxially. Thus for AM 3809, on one side it is 75°-60°-75°, on the other 85°-70°-85°.

The dissepiments are rather globose, and variable in size; the number of series varies considerably, depending on the width of the dissepimentarium. As few as 9, as many as 18 have been seen. Peripherally, the dissepiments slope adaxially at about 65°-70° from the horizontal; in narrow dissepimentaria this inclination gradually increases until the innermost 2-4 series, moderately to strongly elongate, are almost vertical. In wide dissepimentaria there is first a decrease in inclination to as little as 50°, then a gradual increase to about 80°. There is no abrupt change in slope.

$D_t = 0{\cdot}2\ D_c$ to $0{\cdot}35\ D_c$. The tabularium may be a little eccentric. The crowded tabulae are generally incomplete; near the dissepimentarium they are adaxially inclined, arched, and often turned up to meet the dissepiments. At the axis they are flat or gently sagging, with a shallow, weakly to strongly differentiated median depression.

Dimensions of lectotype and paralectotypes

	D_c mm	D_t mm	D_t/D_c	n	n/D_c	L_1	L_2
*AM 3810	*c.* 22	*c.* 6	*c.* 0·27	58	*c.* 2·64	*c.* 0·9*R*	0·65-0·7*R*
*AM 3809	29·4	5·8	0·20	—	—	—	—
*NMP 24207a	24·0	*c.* 7·5	*c.* 0·32	54 ($n'=24$)	2·25	*c.* 0·9*R*	*c.* 0·75*R*
„	19·8	*c.* 7·5	*c.* 0·38	58	2·93	0·81*R*	0·65-0·7*R*
„	*c.* 31	*c.* 7	*c.* 0·3	60	*c.* 2·85	*c.* 0·9-0·95*R*	c. 0·65*R*
*NMP 24207b	19·7	6·6	0·34	—	—	—	—
„	19·4	6·6	0·34	—	—	—	—
„	24·6	7·2	0·29	—	—	—	—
NMP 24208	est. 24	7·0	*c.* 0·3	—	—	—	—
NMP 24209	*c.* 19	—	—	—	—	—	c. 0·77*R*
NMP 24717a	*c.* 16	*c.* 5·5	*c.* 0·34	—	—	—	—
„	*c.* 26·5	*c.* 5·5	*c.* 0·21	50?	*c.* 1·89	0·9-1·0*R*	—
NMP 24718	27·3	6·5	0·24	64	2·34	*c.* 0·9*R*	c. 0·75*R*
mean:	22·5	6·6	*c.* 0·3	57	*c.* 2·5	*c.* 0·9*R*	c. 0·7*R*

* Lectotype sections; note that for both L_1 and L_2 the average length is generally quoted.

Observations on Paralectotypes

WALL STRUCTURE: Section NMP 24718b clearly reveals the trabecular construction of the wall and septa. The trabecular microstructure is obscure, with some suggestions that it is finely monacanthine. Nevertheless the section is clear enough to show that the septa are essentially unitrabecular (Kato 1963), with the occasional interpolation of narrow trabeculae on one side or the other of the axial plane, and the rare occurrence of a side-by-side pair of trabeculae diverging from that plane. The trabeculae have the shape of laths, tapering inwards as the septal dilatation decreases, and inclined inwards and upwards. These laths are stacked with the wide flat sides together, so that in longitudinal section the minimum width is seen. The wall consists of the outer ends of these laths, lined by a very thin epitheca, whose wrinkles reflect the irregularities of the trabeculae (Pl. 2, fig. 3e). The laths here are about 1 mm wide, 0·15 mm thick. In mid-dissepimentarium the thickness may be as little as 0·10 mm, but is usually about 0·12 mm. The width varies considerably according to the septal dilatation. (Compare Strusz 1966, Fig. 1, and p. 545.)

SEPTAL DILATATION: The zones of dilatation appear to be in the form of successive inverse cones of fibrous tissue, organized into trabeculae within the dilated septa, but spreading as even coatings on to the dissepiments. A transverse section intersecting these cones of dilatation thus gives the impression of concentric zones of fusiform dilatation.

$D_t : D_c$: The data are insufficient for rigorous statistical treatment, particularly as there are no juvenile corallites. For the known size range ($D_c > 16$ mm), a plot of D_t/D_c against D_c on logarithmic coordinates strongly suggests an allometric relationship between the two variables. The corallites figured by Philip (1962, Pl. 26, fig. 9, 11-12) from the Tyers area agree well with this pattern (Fig. 2).

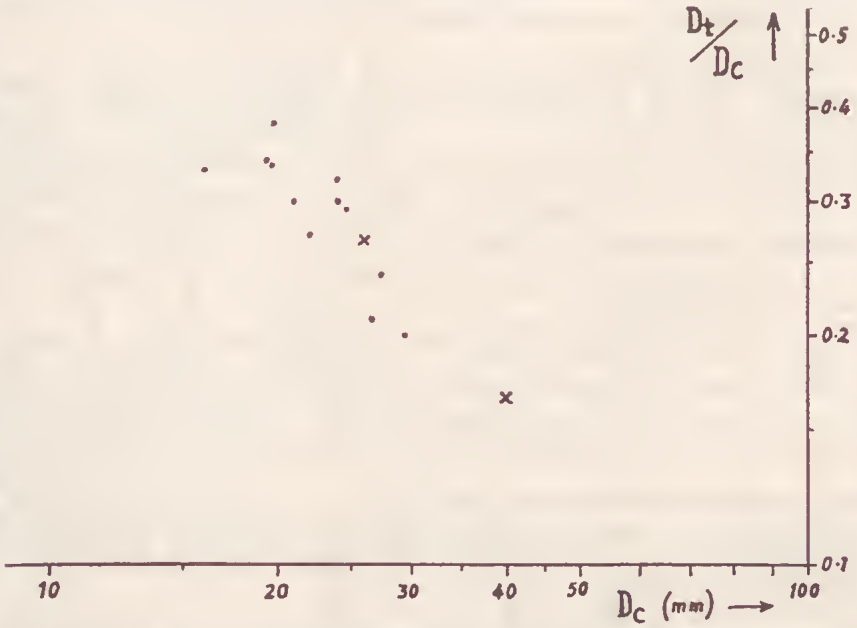

FIG. 2—Plot of D_t/D_c against D_c for *A.* (*N.*) *mansfieldense* on logarithmic coordinates. Philip's figured corallites are shown by crosses.

COMPARISON: Both Hill (1939) and Philip (1962) have remarked on the similar strong peripheral septal dilatation in this species and *Cyathophyllum baculoides* Počta in Barrande 1902 (from Koněprusy and also from the Chalonnes limestone; see Le Maître 1934). Unfortunately neither Počta nor Le Maître figured longitudinal sections, and their descriptions of the horizontal tissue are brief. In transverse section, marked difference from *A.* (*N.*) *mansfieldense* lies in strong vortical rotation of the axially dilated septa, and in the presence peripherally of numerous naotic plates. Počta also reports a higher septal number. *C. baculoides* is strongly reminiscent of *Dohmophyllum* as described by Birenheide (1963), or possibly *Pseudochonophyllum* Soshkina *sensu* Strusz 1966. Longitudinal sections are required before the precise affinities of Počta's species can be ascertained.

Hill's (1942a, p. 146) doubtful example from the Nemingha Limestone of Attunga, N.S.W. consists of a transverse section of two acanthophylloid corals with extremely dilated septa (Pl. 2, fig. 4). The one complete corallite has $D_c = 21{\cdot}4$

mm, D_t = c. 6·5 mm, and n = 42. This septal number is significantly lower than that of corallites of the same diameter from Loyola. Septal dilatation alone is unreliable, but taken with this difference in n/D_c there is little doubt that the Nemingha coral is distinct from *A.* (*N.*) *mansfieldense*. More material is needed before its affinities can be determined.

REMARKS: The first problem met with in analyzing the relationships of this species is the form of the corallum. Of the acanthophylloid species, solitary corals have been placed in *Acanthophyllum* (see Birenheide 1961), fasciculate corals in *Lyrielasma* (see Strusz 1966). It seems likely that *A. mansfieldense* may be at one time solitary, at another weakly fasciculate, forming small clumps of a few corallites. Probably, in the second case, the original corallite has the capacity to form a few buds, which reach full size but do not themselves bud. I have conclusively observed the same phenomenon in some corals from the Garra Formation comparable with *A.* (*A.*) *clermontense* (see Strusz 1966, p. 552). Should these species be considered as essentially colonial, or essentially solitary? Birenheide (1964) has already decided that colony-form is at best a specific character among the solitary and fasciculate Devonian 'cystimorphs'. Among solitary and fasciculate acanthophylloid corals, I consider it is possible to discern two groups. One consists of those species which are exclusively fasciculate, forming colonies by repeated budding—these I would place in *Lyrielasma*. The other consists of species which either never bud, or do so only occasionally, to form small 'clumps' of a few radiating corallites; these are *Acanthophyllum*.

The other problem is that arising from Wedekind's multiplicity of genera, and Birenheide's (1961) revision of these. *A. mansfieldense* does not have the bell-shaped calice such as Birenheide considers typical of the German *A.* (*Acanthophyllum*), yet its calical sides are often sigmoidally curved to a certain extent. On the basis that there is no abrupt strong change in inclination of dissepiments and trabeculae a little abaxially from the tabularium, I am inclined to broaden slightly the scope of the 'inversely conical calice' (*Trichterkelch*) characteristic of the subgenera *Grypophyllum* and *Neostringophyllum*, to include calices such as that of *A. mansfieldense*. The essential features of such a calice are sharp rim, steeply sloping straight or sinuous sides, and concave floor.

The nature and strength of the septal dilatation, and the thick dentate wall, agree most closely with Birenheide's conception of *A.* (*Neostringophyllum*), but it should be kept in mind that the separation of this subgenus from *A.* (*Grypophyllum*) may yet prove invalid. The type of *A.* (*Neostringophyllum*) needs further investigation.

In Strusz (1966, p. 550) the species was grouped with *A. clermontense* as a large-diameter species of *A.* (*Acanthophyllum*), distinguished by its distinctive septal dilatation and smaller number of septa. This is now seen to be incorrect.

OCCURRENCE: As now understood, the species is known with certainty from Loyola and the Tyers R. Boucot et al. (1966) note that the coralline and brachiopod faunas of the two are very close, and indicate a 'probably Upper Siegenian' age.

Acknowledgements

Most of the work for this paper, including a visit to Melbourne which provided the opportunity for a search through the Sweet Collection, was financed by the University of Queensland while I was on the staff of the University College of Townsville. I should like to express my thanks to Mr T. Darragh of the National

Museum for kindly lending me the original specimens, and for permitting new sections to be prepared from the lectotype. Sincere thanks are also due to Dr A. J. Wright for information on the whereabouts of Dun's sections, and to Mr H. O. Fletcher for sending me photographs of them. Prof. D. Hill assisted greatly by her useful criticism of the manuscript. The paper is published by permission of the Director, Bureau of Mineral Resources, Geology and Geophysics.

References

BIRENHEIDE, R., 1961. Die *Acanthopyllum*-Arten (Rugosa) aus Richtschnitt Schönecken-Dingdorf und aus anderen Vorkommen in der Eifel. *Senck. leth.* 42: 77-146, 1-7.

————, 1963. *Cyathophyllum*- und *Dolmophyllum*-Arten (Rugosa) aus dem Mitteldevon der Eifel. *Ibid.* 44: 363-458, 46-62.

————, 1964. Die 'Cystimorpha' (Rugosa) aus dem Eifeler Devon. *Abh. senck. naturf. Ges.* 507: 1-120, 1-28.

BOUCOT, A. J., GILL, E. D., JOHNSON, J. G., LENZ, A. C., & TALENT, J. A., 1966. *Skenidioides* and *Leptaenisca* in the Lower Devonian of Australia (Victoria, Tasmania) and New Zealand, with Notes on Other Devonian Occurrences of *Skenidiodes*. *Proc. Roy. Soc. Vict.* 79: 363-369, 40.

DUN, W. S., 1898. Contributions to the Palaeontology of the Upper Silurian Rocks of Victoria, based on Specimens in the Collections of Mr George Sweet, Part I. *Ibid.* 10: 79-90, 3.

HILL, D., 1939. The Devonian Rugose Corals of Lilydale and Loyola, Victoria. *Ibid.* 51: 219-256, 13-16.

————, 1940. The Middle Devonian Rugose Corals of Queensland, II. The Silverwood-Lucky Valley Area. *Proc. Roy. Soc. Qd.* 51: 150-168, 2-3.

————, 1942a. The Devonian Rugose Corals of the Tamworth District, N.S.W. *J. Proc. Roy. Soc. N.S.W.* 76: 142-164, 2-4.

————, 1942b. Middle Palaeozoic Rugose Corals from the Wellington District, N.S.W. *Ibid.* 76: 182-189, 5-6.

KATO, M., 1963. Fine Skeletal Structures in Rugosa. *J. Fac. Sci. Hokkaido Univ., ser.* 4 (*Geol. Mineral.*) 11 (4): 571-630, 1-3.

LE MAÎTRE, D., 1934. Etudes sur la Faune Calcaires Dévoniens du Bassin d'Ancenis. Calcaire de Chaudefonds et Calcaire de Challones (Maine-et-Loire), *Mém. Soc. géol. Nord* 12: 1-267, 1-18.

PEDDER, A. E. H., 1966. The Devonian tetracoral *Haplothecia* and new Australian phacellophyllids. *Proc. Linn. Soc. N.S.W.* 90: 181-189, 6.

PHILIP, G. M., 1962. The Palaeontology and Stratigraphy of the Siluro-Devonian Sediments of the Tyers Area, Gippsland, Victoria. *Proc. Roy. Soc. Vict.* 75: 123-246, 11-36.

POČTA, P., 1902. Anthozoaires et Alcyonaires. T. 8 (2) of: BARRANDE, J. *Système Silurien du centre de la Bohême.*

STRUSZ, D. L., 1966. Spongophyllidae from the Devonian Garra Formation, New South Wales. *Palaeontology* 9: 544-598, 85-96.

Explanation of Plate

PLATE 2

The photography for fig. 1 and 3 was done by Mr. C. Zawartko of the Bureau of Mineral Resources; fig. 2 is by courtesy of the Australian Museum; fig. 4 was taken by the writer. All are × 2·0 except fig. 3c, d, which are × 5·0.

Fig. 1—*Acanthophyllum* (*Neostringophyllum*) *mansfieldense*. Lectotype, NMP 24207; the longitudinal section (b) is of the top right corallite in (a).

Fig. 2—*A.* (*N.*) *mansfieldense*. Lectotype, AM 3809 (longitudinal section b) and AM 3810 (transverse section a); original sections, figured Dun 1898, Pl. 3, fig. 3-4.

Fig. 3—*A.* (*N.*) *mansfieldense*. Paralectotype, NMP 24718. Enlargements (c, d) show details of the trabecular construction of wall and septa. The small corallite in 3b is *Thamnophyllum reclinatum*.

Fig. 4—'*Acanthophyllum ?mansfieldense*' of Hill 1942a, Pl. 2, fig. 1. SUP 7254, Nemingha Limestone, Attunga, N.S.W. Note the difference in mode of septal dilatation from *A.* (*N.*) *mansfieldense*.